

38
Session X. Airborne Doppler Radar / Industry

N91-24151

Status of Collins Research
Roy Robertson, Collins

NASA / FAA

THIRD COMBINED AIRBORNE WINDSHEAR

REVIEW MEETING

OCTOBER 16 - 18, 1990

ROCKWELL INTERNATIONAL

COLLINS AIR TRANSPORT DIVISION

R. E. ROBERTSON

TOPICS

WINDSHEAR RADAR PROGRAM

FUTURE PLANS

WINDSHEAR RADAR PROGRAM

GOALS

- WEATHER RADAR WINDSHEAR DETECTION
 - LARGE INSTALLED BASE
 - MINIMAL CHANGES TO AIRCRAFT
- USEFUL DETECTION CHARACTERISTICS
 - HIGH POD, LOW FAR
 - WET AND DRY MICROBURSTS
 - ACCEPTABLE CONSISTENT WARN TIMES
- EFFECTIVE FOR TAKEOFF & LANDING
- STAND ALONE OR COMBINED WITH OTHER SYSTEMS

WINDSHEAR RADAR PROGRAM

OVERVIEW

- MODIFICATION TO WXR-700
 - FULLY-COHERENT ARCHITECTURE
 - UPGRADE SIGNAL PROCESSING
 - IMPROVE RF STABILITY
- FLIGHT TEST PLAN
 - COMPANY SABRELINER BEGINNING NOV '90
 - CONTINENTAL 737 -- APRIL '91 THRU SEPT '91

WINDSHEAR RADAR PROGRAM

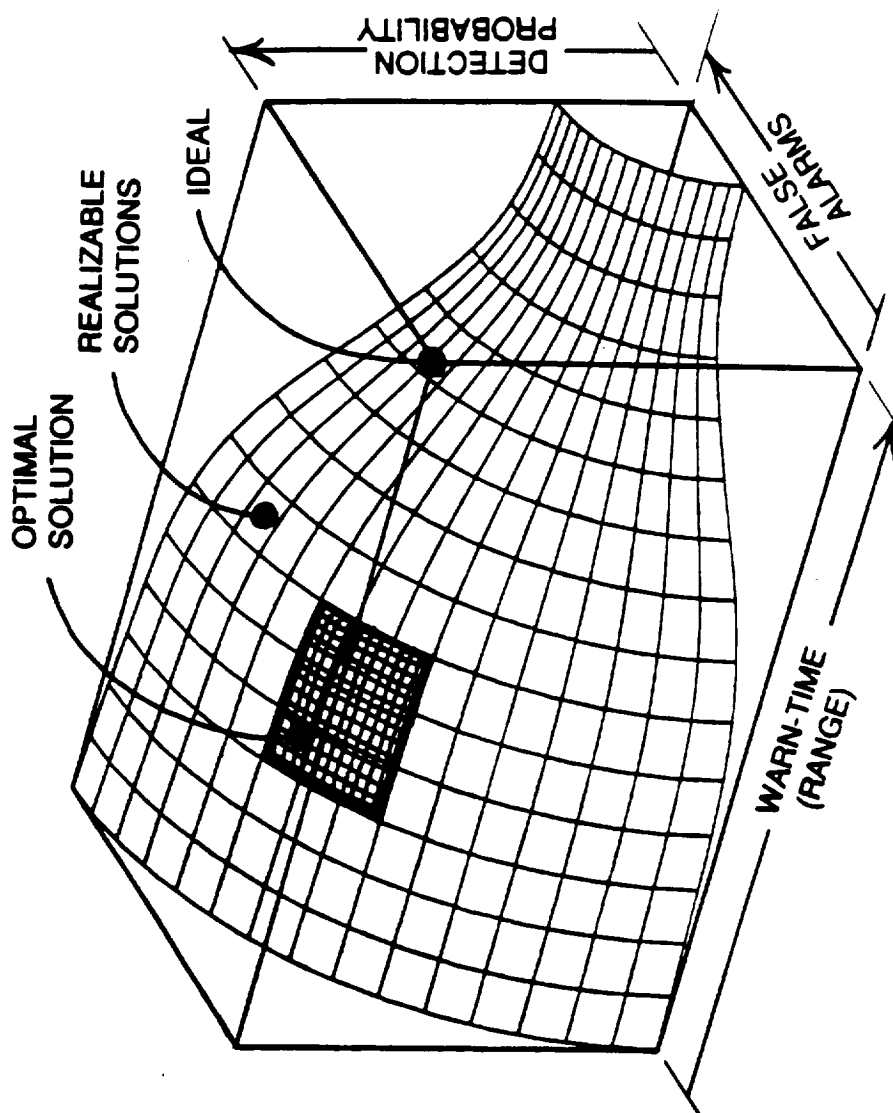
TECHNICAL APPROACH

- TIME SHARE WEATHER AND WINDSHEAR DETECTION
 - MAINTAIN WEATHER AVOIDANCE DISPLAY
 - AUTOMATIC ANTENNA POSITIONING FOR W/S SWEEP
 - PROTECTION OVER 30° SECTOR
- EXTRACT VELOCITY PROFILE ALONG FLIGHT PATH
 - DIRECT MEASURE OF HORIZONTAL COMPONENT
 - VERTICAL COMPONENT INFERRED
- HAZARD DETERMINATION
 - SIGNAL DECONTAMINATION / FILTERING
 - HAZARD CALCULATION / THRESHOLDING
 - OUTPUTS AVAILABLE
 - WINDSHEAR ALERT
 - VELOCITY PROFILE VS RANGE
 - HAZARD PROFILE VS RANGE

WINDSHEAR RADAR PROGRAM

DESIGN CONSIDERATIONS

- HAZARD FACTOR ESTIMATION
 - HORIZONTAL VELOCITY COMPONENT
 - ASYMMETRIC EVENTS, MICROBURST LINES
 - DESCENDING MICROBURSTS
- "WORST CASE" EVENTS DRIVE SYSTEM DESIGN
 - VERY DRY, SMALL MICROBURSTS
- PERFORMANCE TRADE-OFFS
 - DETECTION RANGE
 - PROBABILITY OF DETECTION
 - FALSE ALARM RATES

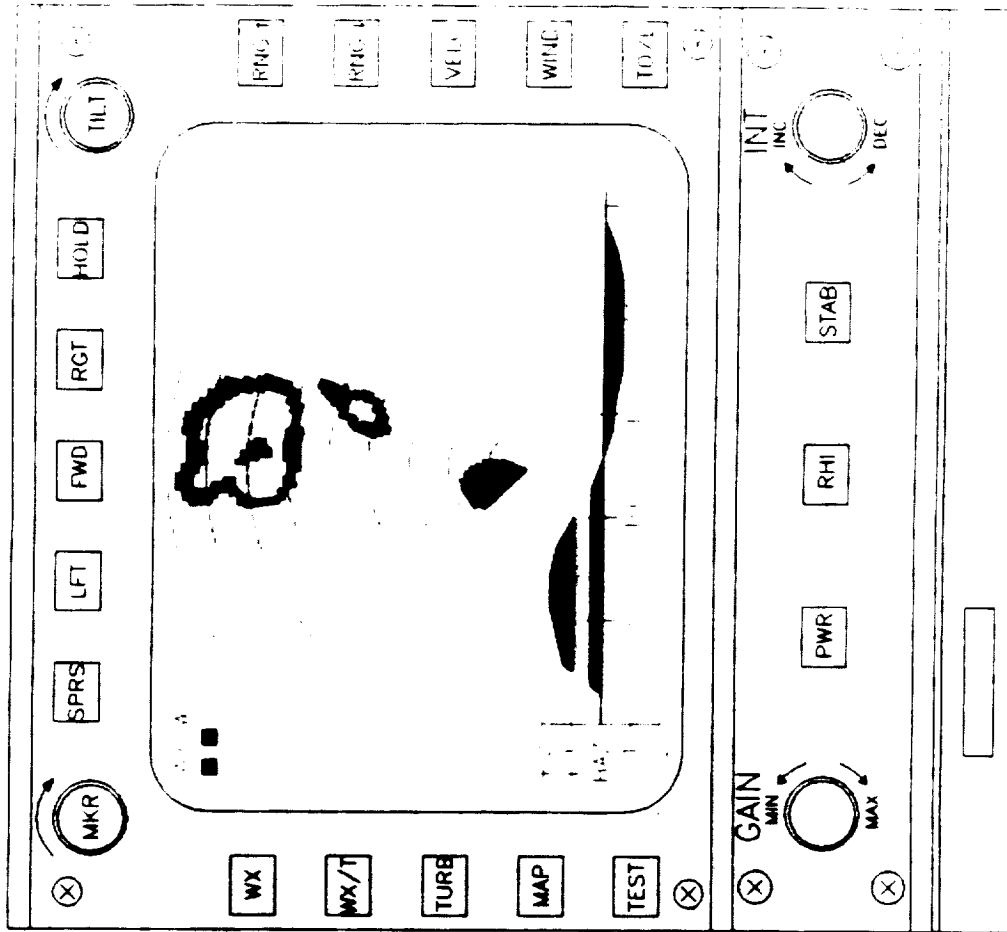


WINDSHEAR PERFORMANCE TRADEOFFS

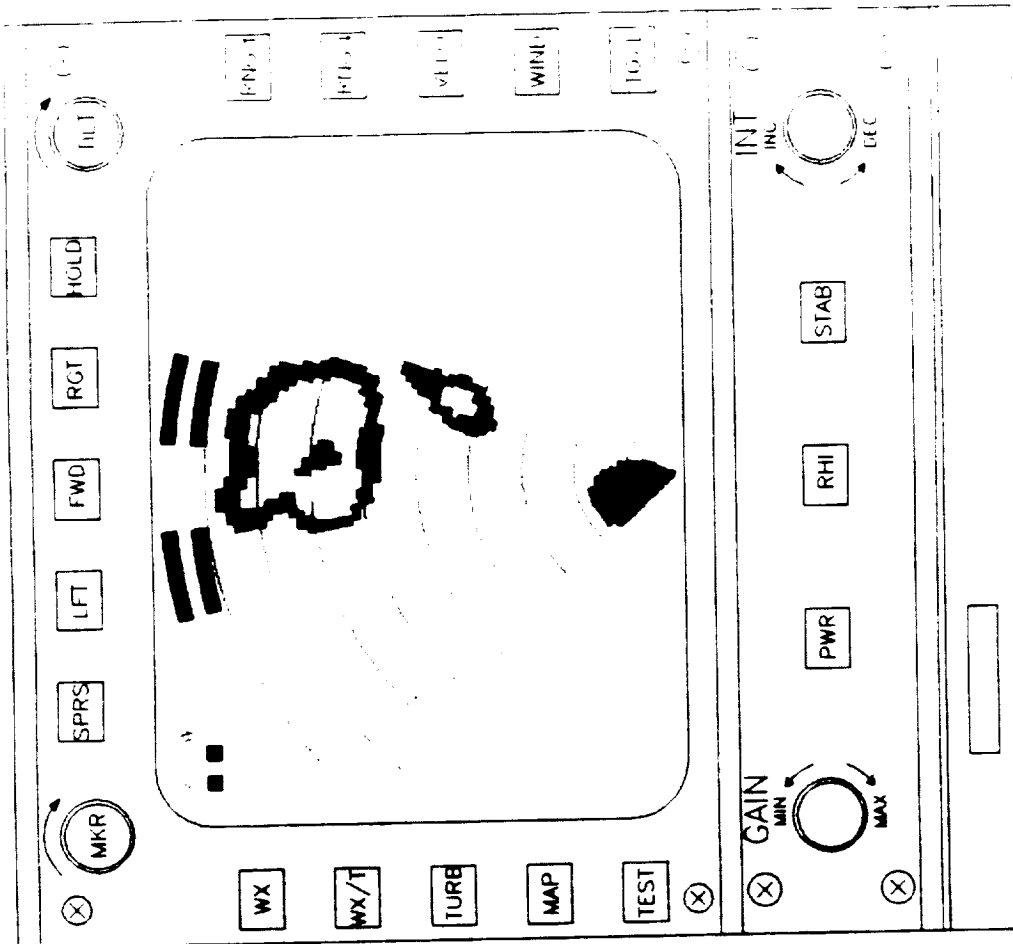
WINDSHEAR RADAR PROGRAM

SYSTEM CONSIDERATIONS

- EXECUTIVE ALERT
 - AURAL, VISUAL WARNING
 - DISCRIMINATE BETWEEN PREDICTIVE/REACTIVE WARNINGS
- GRAPHIC DISPLAY
 - INTERPRETIVE DATA
 - SITUATION AWARENESS
 - AVOIDANCE INFORMATION
- LIMITED INPUT PATH TO PILOT
 - HIGH WORKLOAD -- STRESS
 - RESTRICTED VISUAL SCAN



WEATHER/WINDSHEAR DISPLAY



WEATHER/WINDSHEAR DISPLAY

WINDSHEAR RADAR PROGRAM

CERTIFICATION

- PERFORMANCE REQUIREMENTS NOT DEFINED
 - DETECTION RANGE
 - POD / FAR
 - COVERAGE
- BURDEN OF PROOF REQUIREMENTS
 - "INTENDED FUNCTION" CERTIFICATION
 - FLIGHT DATA (PENETRATIONS?)
 - ANALYSIS / SIMULATION
- STAND ALONE WITHOUT REACTIVE BACKUP

FUTURE PLANS

- **MULTI-SENSOR COMBINATIONS**
 - **RADAR / RADIOMETER / REACTIVE**
 - **SIMPLER SENSOR REQUIREMENTS**
- **ADDITIONAL CAPABILITIES**
 - **CLEAR AIR TURBULENCE**
 - **IMPROVED WINDSHEAR**
- **CO-OPERATIVE DETECTION**
 - **CROSS ATTENTIVE SENSORS**

Status of Collins Research - Questions and Answers

Q: PAUL KELLY (21st Century Technology) - Given the fact that at lower altitudes radar is most susceptible to ground clutter effects and given the fact that microbursts are frequency wet at higher altitudes and dry at lower altitudes, it is obvious that a Doppler based system shows its greatest weakness in the zone in which the information from it is most critical for flight safety. Given the cost of a shear alerting system, airline decision makers will have to be very pragmatic in evaluating competing systems. Does this not illustrate a great need in the industry for some mechanism for codifying and indexing prediction effectiveness on a qualitative and quantitative basis to provide a tool for decision makers in system selection.

A: ROY ROBERTSON (Collins) - The answer is yes. You are correct, the tendency is that radar do act in the direction which you say, low altitude, dry microburst, are difficult environments for the radar to operate. However, I will not say that the radar would be ineffective. We, frankly, are optimistic that radar will still be quite effective in that environment. Your question about the indexing and coding, or method of categorizing the effectiveness of different systems, is a very complicated question. It's the combined effort of everyone at this review meeting to try to determine what effectiveness is and how effective individual sensors are. That involves defining the environmental set as well as the performance of individual sensors. That requires a great deal of data. Analysis can only take that question so far. So until a body of experience is gained on individual predictive sensors, that question cannot be answered. The likely result is that different sensors will excel in different areas. Then it will be up to the airline to perceive what individual properties are more valuable to an airline and that will be different from one airline to another.

PAUL KELLY (21st Century Technology) - There has to be some emphasis on categorizing the degree of effectiveness because we have to do something about giving airline management, which is where the bottom line is, some tool for evaluating competing systems. That's the bottom line that all of our discussions relate to and hence the criticality of our addressing this factor.

ROY ROBERTSON (Collins) - I think that the sum body of knowledge arising from all this effort will certainly move in that direction.

Q: PAUL KELLY (21st Century Technology) - Does the onus for such a code and indexing arrangement not fall on the FAA or is the FAA adopting the position that the initiative will have to come from the industry and expecting the aviation industry to do what it did with the aircraft aging issue when the industry drew up the recommendations and presented them to Sam Skinner for signature?

A: HERB SCHLICKENMAIER (FAA) - You're ahead of me Paul on what the industry did with Sam Skinner. What we've done in this area is as we've done before, work with the industry on what is perceived as a joint industry need. The rationale for the FAA getting together with NASA in the first place, first back in '86 and then again this fiscal year on the new agreement, was to formalize some sort of a structure for conducting the research to look into the questions. But as Roy was saying before, there are some questions in this matter that need to be addressed that are not pertinent to government research. There is not that much expertise quite honestly, at least within the civil aviation side, for the marketing, development and cost effective maintenance and distribution of a piece of avionics into the civil air carrier fleet. I have yet to brief the associate administrator for marketing in the FAA. Those kinds of decisions and questions need to rest with the

Boeings, Douglas, Lockheeds and their customer base. That has as much of an effect on the final design and decision of what the technology is and how it addresses the problem.

Session XI. Airborne Doppler Radar / NASA

PRECEDING PAGE BLANK NOT FILMED

